Effect of feeding by *Metadelphax propinqua* (Fieber)(Homoptera, Delphacidae) on barley

MIKKO RAATIKAINEN, TERTTU RAATIKAINEN and ARJA VASARAINEN

RAATIKAINEN, M., RAATIKAINEN, T. & VASARAINEN, A. 1994. **Effect of feeding by *Metadelphax propinqua* (Fieber) (Homoptera, Delphacidae) on barley.** Agricultural Science Finland 3: 513–517. (University of Jyväskylä, Department of Biological and Environmental Science, P. O. Box 35, FIN-40351 Jyväskylä, Finland and Agricultural Research Centre of Finland, Institute of Plant Protection, FIN-31600 Jokioinen, Finland.)

The effect of feeding by the Turkish *Metadelphax propinqua* on barley was investigated in Finland. The number of *M. propinqua* nymphs and the length of their feeding period on barley did not have any major effects on the barley plants. *M. propinqua* males had a greater effect on the properties of barley than did the nymphs. The effect of *M. propinqua* females on the barley was much greater than that of either the nymphs or males. Their number and the length of feeding time lowered the length and weight of plants, the number of grains, the grain yield and the 1000-grain weight.

Key words: feeding period, female, male, nymph

Introduction

In 1969–1970 we investigated cereal diseases transmitted or caused by aphids and leafhoppers in Turkey. Our interest focused on the biology of *Metadelphax propinqua* (Fieber) (Homoptera, Delphacidae), also (RAATIKAINEN and VASARAINEN 1990), a planthopper widely distributed in the Palaearctic and Nearctic region (METCALF 1943). According to DLABOLA (1957), it is also common in Turkey. We were primarily concerned with the damage it does to barley.

Material and methods

We started with an investigation of the ecology of *M. propinqua* at Bornova in western Turkey and continued with trials at Tikkurila in Finland. The planthoppers were collected from a field at Bornova. The tests were conducted from September 1971 to March 1972 in a glasshouse at a temperature of 20–25°C. The test plant was barley (cultivar Tammi). The plants were sown in 43 x 25 x 12-cm wooden boxes lined with polyethylene film. The bottoms of the boxes were perforated to allow drainage. Seeds of test plants were sown in six parallel rows, four seeds to each row, at equal distances from one another and at a depth of 3 cm. During test feeding periods each planthopper was caged with one seedling under a cylinder of PVC plate, 3 cm in diameter and 25 cm tall; the upper end was covered with gauze. There were also two ventilation openings near the bottom. Control plants were caged in the same manner.

The number of planthoppers on one plant in the rearing box was 0, 1, 2 or 4 and the length of the feeding period was 4, 8 or 16 days. The trials were made with nymphs, males and females. The

Table 1. Effect of feeding by *Metadelphax propinqua* nymphs on barley.

Property measured	No. of planthoppers/plant					Feeding period, days				Planthopper x feeding F
	0	1	2	4	F	4	8	16	F	
Length of plant after 22 days, cm	19.9	19.6	19.7	17.8	1.89	19.5	18.7	19.5	0.53	3.56**
Total length of mature plant, cm	64.7	60.0	58.2	56.7	1.91	60.9	60.6	58.1	0.51	
No. of shoots	2.1	2.2	2.1	2.2	0.06	2.2	2.1	2.2	0.11	
Dry weight of plant, mg	1489.9	1364.0	1274.2	1147.1	4.15**	1439.1	1347.1	1170.2	4.94**	2.27**
No. of grains on main shoot	11.1	9.3	9.1	10.0	0.73	10.1	10.0	9.5	0.12	
No. of grains on secondary shoots	10.2	10.7	9.3	7.6	0.80	10.3	9.8	8.3	0.61	
No. of grains on plant	21.3	20.0	18.4	17.6	2.14	20.4	19.8	17.8	1.92	
Grain yield per main shoot, mg	398.8	313.5	313.2	333.8	1.26	348.8	345.6	325.0	0.17	
Grain yield per secondary shoots, mg	298.3	326.6	275.3	225.7	0.82	315.9	219.8	236.8	0.99	
Grain yield per plant, mg	697.1	640.1	588.5	559.4	2.86*	664.6	637.4	561.8	2.95	2.43*
1000-grain weight on main shoot, g	32.0	24.6	26.5	24.5	2.65*	27.0	27.6	26.1	0.15	
1000-grain weight on secondary shoots, g	15.7	18.7	15.3	14.9	0.69	16.0	15.7	16.8	0.09	

test plants were six days old at the beginning of the trials. The length of the day was 16–19 h. The plant properties measured are listed in Tables 1–3.

The statistical method used was analysis of variance, and statistical significance is indicated by asterisks as follows: *** = $P < 0.001$, ** = $P < 0.01$ and * = $P < 0.05$.

Results

The number of *M. propinqua* nymphs and the length of their feeding period (time of stay) on barley did not have any major effect on the plant properties measured (Table 1). The most important change occurred in the dry weight of the plants, which decreased significantly due to the effect of both the number of nymphs and the length of their feeding period. The combined effect of the number of nymphs and the length of their feeding period on the length of barley plants was significant 22 days after sowing. The number of nymphs lowered the grain weight of whole plants and the 1000-grain weight of the main shoot almost significantly.

M. propinqua males had a more marked effect on the properties of barley than did the nymphs (Table 2). The greater the number of males and the longer the time that had passed since feeding, the less the barley grew in length. Further, the greater the number of males on a plant, and the longer the feeding period, the more the weight of the plant decreased. Feeding led to a decrease in the number and weight of grains of the whole plant and secondary shoots.

The effect of *M. propinqua* females on the properties of barley was much greater than that of either males or nymphs (Table 3). The number of females and the length of their feeding period

Table 2. Effect of feeding by *Metadelphax propinqua* males on barley.

Property measured	No. of planthoppers/plant					Feeding period, days				Planthopper x feeding F
	0	1	2	4	F	4	8	16	F	
Length of plant after 22 days, cm	19.2	19.0	17.3	16.4	5.12**	18.3	17.0	18.6	2.82	
Length of plant after 30 days, cm	29.7	32.2	29.3	29.0	1.33	31.0	30.0	29.1	0.75	
Length of plant after 39 days, cm	50.8	51.5	48.5	47.3	1.24	50.6	49.9	47.8	1.07	
Length of plant after 46 days, cm	57.7	54.7	51.6	50.6	4.70**	54.1	54.3	52.5	0.60	
Length of mature plant (tip of uppermost sheath to base of panicle), cm	59.2	56.4	52.6	52.5	6.77***	55.2	56.7	53.6	2.03	
Total length of mature plant, cm	68.7	65.6	60.4	61.1	5.52***	63.6	66.5	61.7	2.85	
No. of shoots	1.4	1.7	1.8	1.8	3.10*	1.7	1.5	1.7	1.75	
Dry weight of main shoot, mg	1129.3	845.7	744.9	692.8	10.57***	895.8	918.0	745.8	3.23*	
Dry weight of secondary shoots, mg	241.3	359.8	371.0	260.6	1.01	470.5	227.3	226.8	5.98**	
Dry weight of plant, mg	1370.7	1205.5	1115.9	953.4	6.41***	1366.3	1145.3	972.6	10.96***	
No. of grains on main shoot	10.5	8.8	7.6	7.0	1.77	8.3	9.9	7.2	1.79	
No. of grains on secondary shoots	4.3	7.2	7.2	5.2	1.05	9.3	4.8	3.9	5.50**	
No. of grains on plant	14.8	16.0	14.8	12.2	1.21	17.6	14.6	11.1	6.80**	
Grain yield per main shoot, mg	391.3	318.5	275.1	249.9	2.32	329.8	341.6	2544.7	1.79	
Grain yield per secondary shoots, mg	91.4	165.2	152.7	107.5	1.29	206.9	102.1	78.5	6.42**	
Grain yield per plant, mg	482.8	483.7	427.8	357.4	2.16	536.8	443.8	333.2	8.38***	
Age of main shoot, days	95.9	93.6	95.4	93.9	0.34	94.3	94.4	95.4	0.14	
1000-grain weight on main shoot, g	29.9	33.1	27.5	28.4	0.89	30.6	30.5	28.0	0.41	
1000-grain weight on secondary shoot, g	5.7	10.0	9.3	8.4	1.27	10.7	6.1	8.2	2.51	

usually lowered very significantly or significantly the length and weight of plants, the number of grains, the grain yield and the 1000-grain weight. The effect on growth was most striking at the end of the feeding period, but thereafter the plant seeded and gradually recovered.

Discussion

Our earlier studies (BREMER and RAATIKAINEN 1975) indicated that the planthopper individuals we investigated did not transmit viruses.

M. propinqua is a small planthopper that dam-

Table 3. Effect of feeding by *Metadelphax propinqua* females on barley.

Property measured	No. of planthoppers/plant					Feeding period, days				Planthopper x feeding F
	0	1	2	4	F	4	8	16	F	
Length of plant after 22 days, cm	19.4	13.5	11.8	8.2	85.42***	16.0	13.4	10.3	43.04***	8.10***
Length of plant after 30 days, cm	30.2	23.4	21.4	14.3	39.92***	26.9	23.8	16.4	35.89***	4.31***
Length of plant after 39 days, cm	50.7	41.1	37.2	25.7	38.96***	46.1	41.5	28.4	41.06***	2.87*
Length of plant after 46 days, cm	56.8	46.7	42.7	31.2	36.36***	52.1	47.0	33.9	38.18***	2.49*
Length of mature plant (tip of uppermost sheath to base of panicle), cm	58.4	50.2	46.7	38.4	24.67***	54.6	50.8	39.8	28.30***	
Total length of mature plant, cm	67.9	58.0	54.9	45.4	20.07***	64.2	59.6	45.8	28.33***	
No. of shoots	1.8	1.3	1.3	1.2	7.12***	1.6	1.3	1.3	4.96**	
Dry weight of main shoot, mg	1081.9	766.4	605.1	433.7	26.06***	918.6	760.4	486.4	21.83***	
Dry weight of secondary shoots, mg	586.8	149.1	110.7	118.6	8.82***	403.8	179.2	141.0	4.44*	
Dry weight of plant, mg	1668.8	915.5	715.8	552.3	34.38***	1322.3	939.6	627.4	22.82***	
No. of grains on main shoot	9.3	8.1	5.8	4.8	4.38**	8.3	7.5	5.2	3.66*	
No. of grains on secondary shoots	10.1	2.7	2.3	1.7	8.82***	6.6	2.9	3.0	3.39*	
No. of grains on plant	19.3	10.8	8.1	6.5	17.19***	14.9	10.4	8.2	8.24***	
Grain yield per main shoot, mg	337.7	278.6	187.3	129.3	8.64***	290.4	249.3	159.9	5.95**	
Grain yield per secondary shoots, mg	248.3	54.0	48.0	48.6	8.10***	167.2	75.1	56.9	3.84*	
Grain yield per plant, mg	586.0	332.6	235.3	177.8	21.04***	457.6	324.4	216.8	12.55***	
Age of main shoot, days	98.4	101.5	101.8	95.5	0.96	95.8	99.3	102.8	1.78	
1000-grain weight on main shoot, g	28.9	28.1	22.0	16.1	5.95***	29.2	25.3	16.8	8.93***	
1000-grain weight on secondary shoot, g	9.4	4.0	2.9	2.9	4.83**	7.1	3.6	3.7	2.55	

ages a plant in two ways. It draws nourishment out of the plant and simultaneously injects into it saliva which helps to digest the food and injurious to the plant. The combined effect of these measures is less with nymphs than with adults, and with male than with female adults. This may be due to the fact that females start laying eggs approximately 1–5 days after emergence and the number of eggs is greater than that of other planthoppers studied (RAATIKAINEN and VASARAINEN 1990). Females thus need more food than males and so cause more injury to the plant than either males or nymphs.

There is great variation in the abundance of *M. propinqua* and, from time to time, it may cause a significant decrease in the yield of grasses.

References

BREMER, K. & RAATIKAINEN, M. 1975. Cereal diseases transmitted or caused by aphids and leafhoppers in Turkey. Annales Academiae Scientiarum Fennicae Series A, IV Biologica 203: 1–14.

DLABOLA, J. 1957. Results of the zoological expedition of the National Museum in Prague to Turkey. 20. Homoptera, Auchenorrhyncha. – Acta Entomologica Musei Nationalis Prague 31, 469: 19–68.

METCALF, Z.P. 1943. General catalogue of the Hemiptera IV, Fulgoroidea. 3, Araeopidae (Delphacidae). – Northampton, Mass. U.S.A. 552 p.

RAATIKAINEN, M. & VASARAINEN, A. 1990. Biology of *Metadelphax propinqua* (Fieber) (Homoptera, Delphacidae). – Entomologica Fennica 1: 145–149.

Manuscript received April 1993

SELOSTUS

Metadelphax propinqua -kaskaan imennän vaikutus ohraan

MIKKO RAATIKAINEN, TERTTU RAATIKAINEN ja ARJA VASARAINEN

Jyväskylän yliopisto ja Maatalouden tutkimuskeskus

Metadelphax propinqua -kaskaan imennän aiheuttamia vioituksia ohralle tutkittiin 1970-luvun alussa. Kokeissa *M. propinqua* -lajin toukkia, koiraita ja naaraita laitettiin 0, 1, 2 ja 4 kappaletta ohrille neljäksi, kahdeksaksi ja kuudeksitoista vuorokaudeksi. Kokeessa olleen ohran lajike oli Tammi.

Toukkien imennän vaikutuksesta ohran kuivapaino, jyvien paino ja pääverson 1000-jyvän paino jäivät vähän pienemmiksi kuin terveiden ohrien.

Koiraiden imennän vaikutuksesta ohran pituus, kuivapaino, jyvämäärä ja jyväsato jäivät pienemmiksi kuin terveiden ohrien.

Naaraiden imennän vaikutuksesta melkein kaikki tutkitut ominaisuudet jäivät paljon pienemmiksi kuin terveiden ohrien. Naaraat olivat ohran pahoja tuholaisia, jos niitä oli paljon ja ne pääsivät ohriin kasvin ollessa pieninä oraina. Vioitus aiheutunee kaskaan kasviin laskemasta syljestä ja kasvista ottamasta ravinnosta. Viimeksi mainittu lienee pääsyy, sillä naaras alkaa munia 1–5 vuorokautta aikuistumisen jälkeen ja ottaa siitä alkaen usean viikon aikana paljon ravintoa ohrista.